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(54) **MANAGING A CACHE FOR STORING ONE OR MORE INTERMEDIATE PRODUCTS OF A COMPUTER PROGRAM**

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(30) **Foreign Application Priority Data**

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G06F 9/50 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 12/128*** (2013.01); ***G06F 9/5016*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 12/128
See application file for complete search history.

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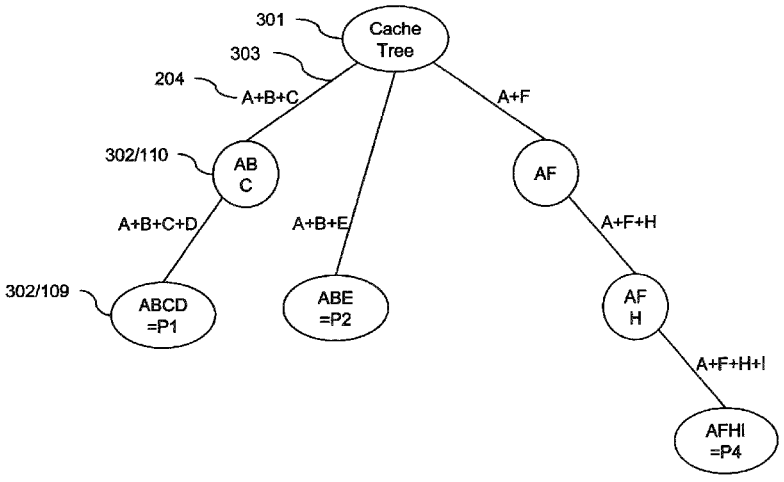
(57) **ABSTRACT**

A method, program product and a system is provided for managing a cache. The method includes analyzing at least an intermediate product of a computer program. The intermediate product is produced by the computer program in response to a set of control inputs. The method also includes determining a resource measure associated with the first intermediate product and determining a resource measure value for the first intermediate product using a first set of control inputs> The first intermediate product is stored in the cache upon determination that the resource measure value exceeds a predetermined resource threshold.

19 Claims, 6 Drawing Sheets



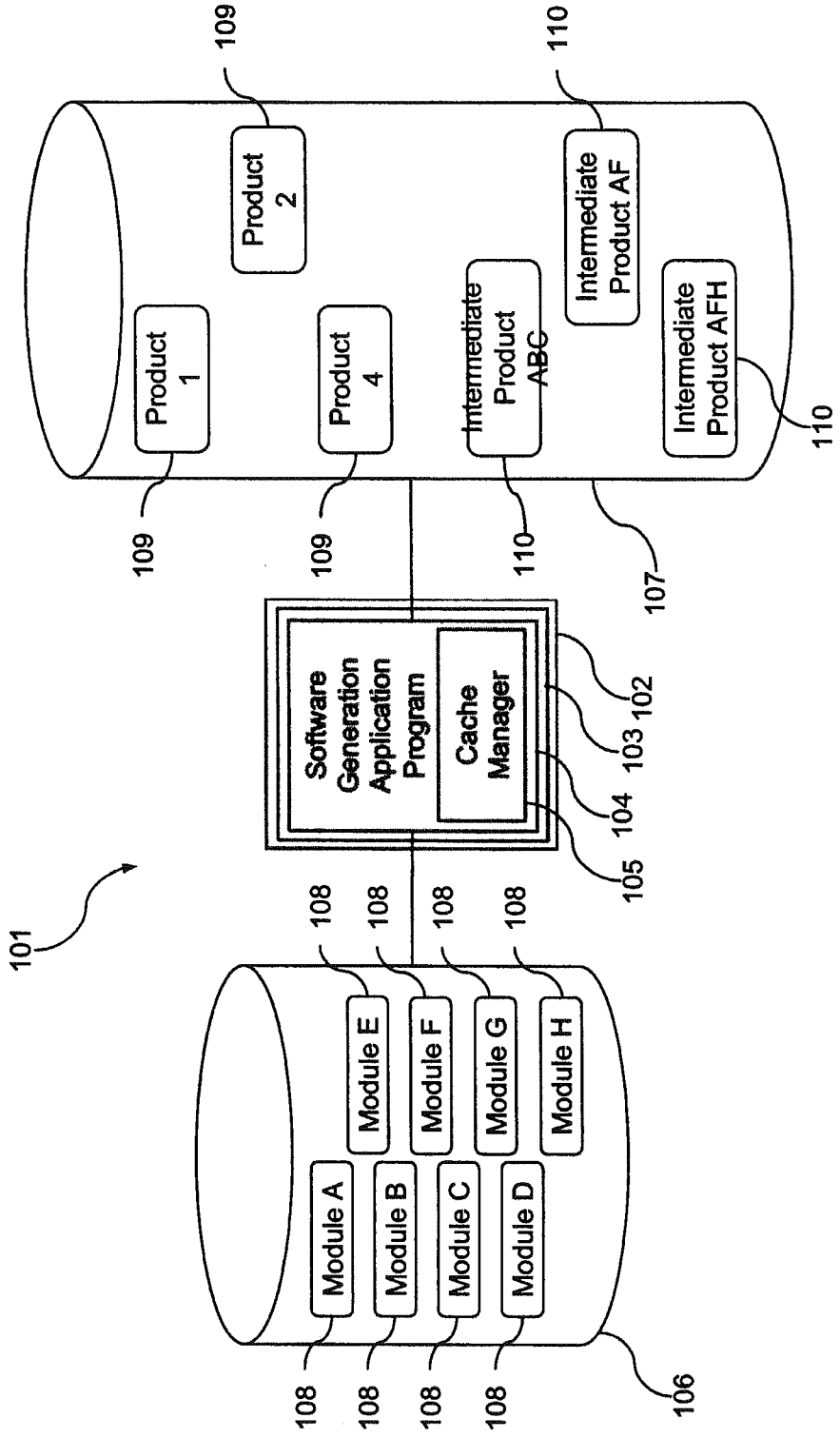

109
110
Product 1
Product 2
Product 4
Intermediate Product ABC
Intermediate Product AF
Intermediate Product AFH
109
109
110
107
110
Software Generation Application Program
Cache Manager
102
103
104
105
101
108
108
108
108
Module A
Module B
Module C
Module D
Module E
Module F
Module G
Module H
108
108
108
108
106

Figure 1

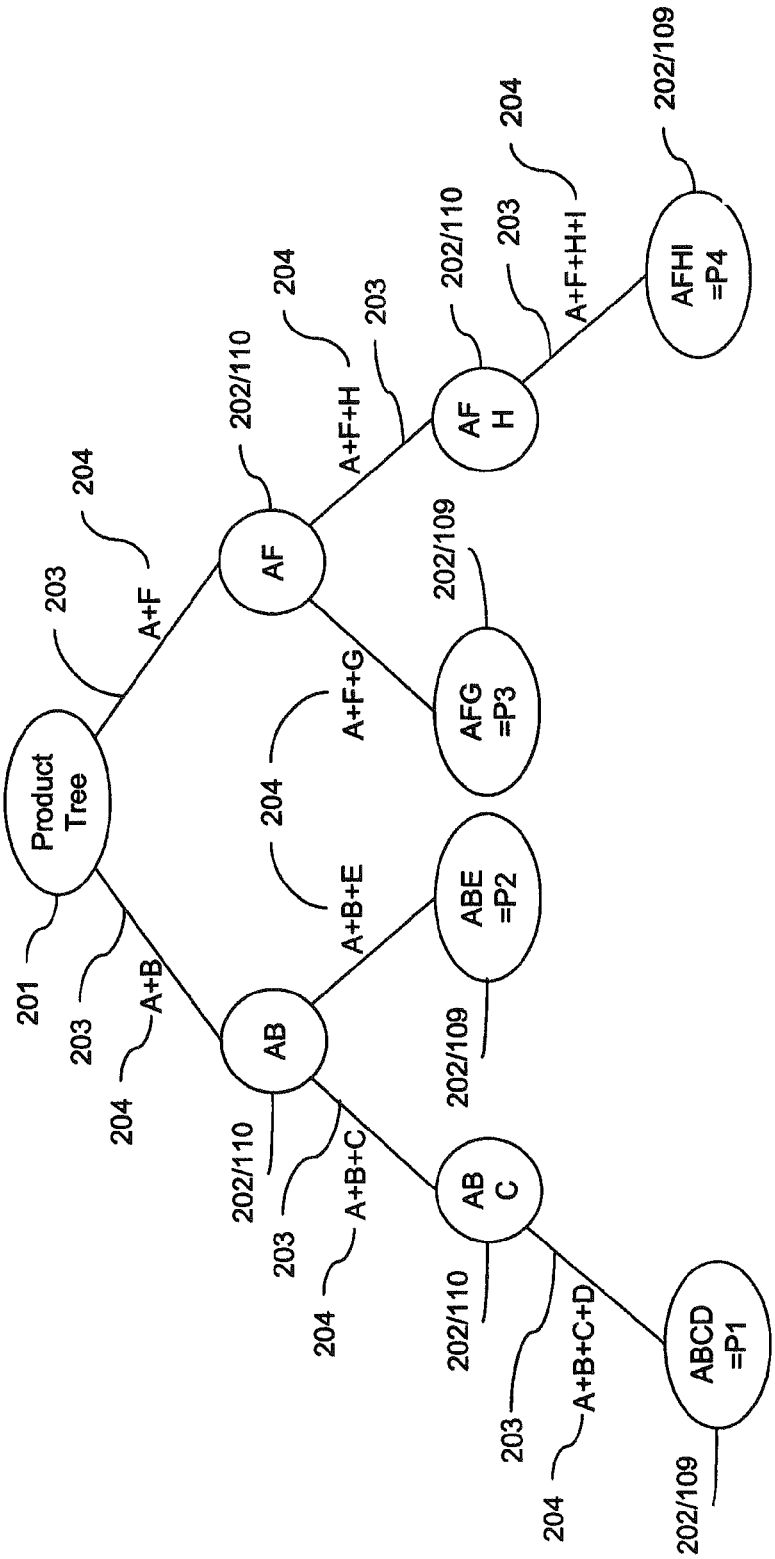

Product Tree
201
203
204
A+B
A+F
AB
AF
202/110
202/110
203
204
A+B+C
A+B+E
A+F+G
A+F+H
AB C
ABE =P2
AFG =P3
AF H
202/109
202/109
202/110
202/110
203
203
204
204
A+B+C+D
A+F+H+I
ABCD =P1
AFHI =P4
202/109
202/109

Figure 2

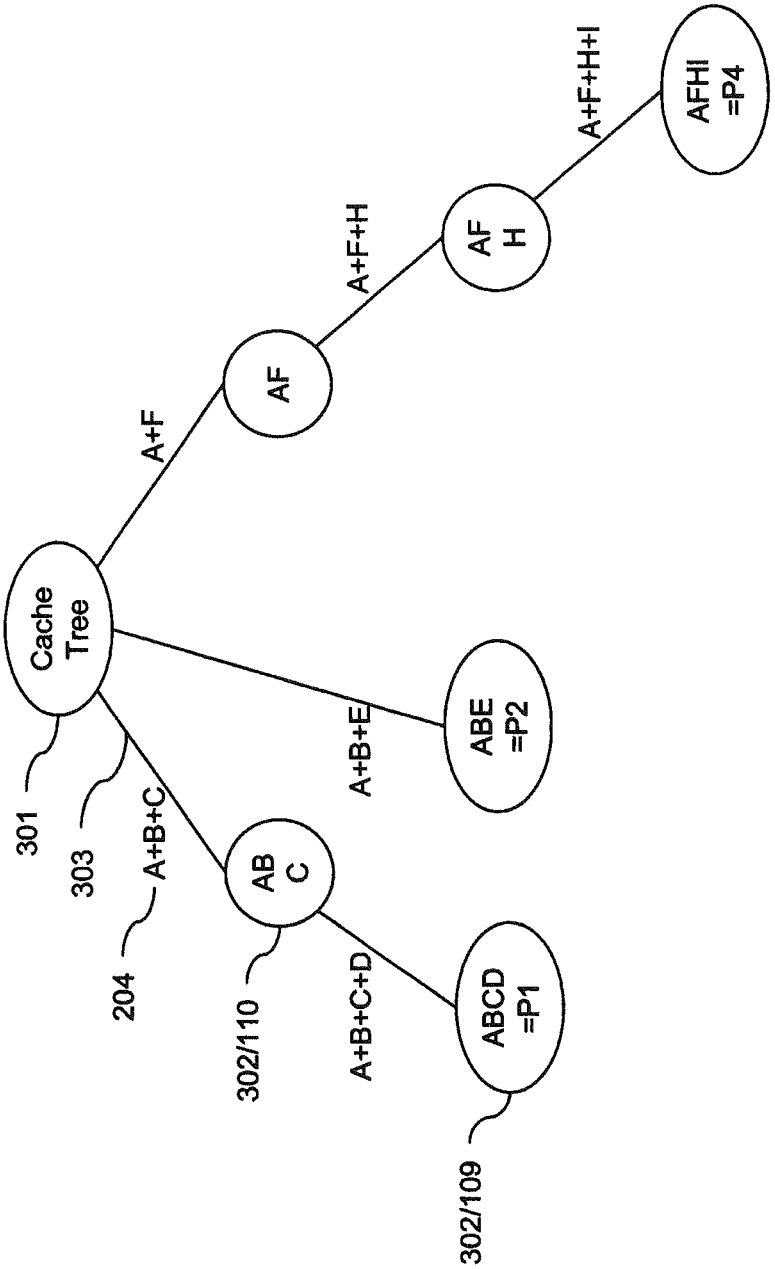

Cache Tree
301
303
A+B+C
204
AB C
302/110
A+B+C+D
ABCD =P1
302/109
A+B+E
ABE =P2
A+F
AF
A+F+H
AF H
A+F+H+I
AFHI =P4

Figure 3

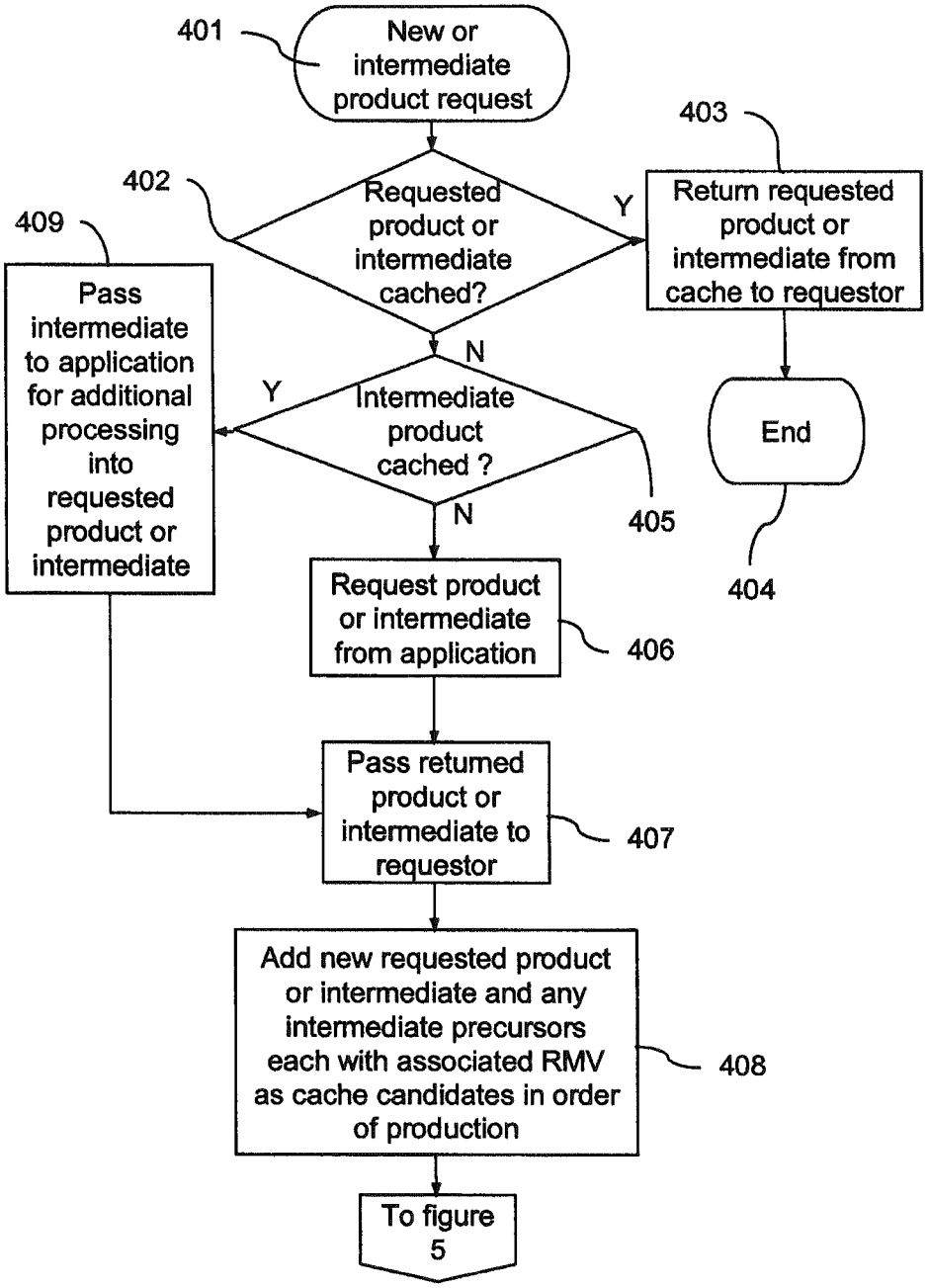

401
New or intermediate product request
402
Requested product or intermediate cached?
Y
403
Return requested product or intermediate from cache to requestor
End
404
N
Intermediate product cached ?
Y
409
Pass intermediate to application for additional processing into requested product or intermediate
N
405
Request product or intermediate from application
406
Pass returned product or intermediate to requestor
407
Add new requested product or intermediate and any intermediate precursors each with associated RMV as cache candidates in order of production
408
To figure 5

Figure 4

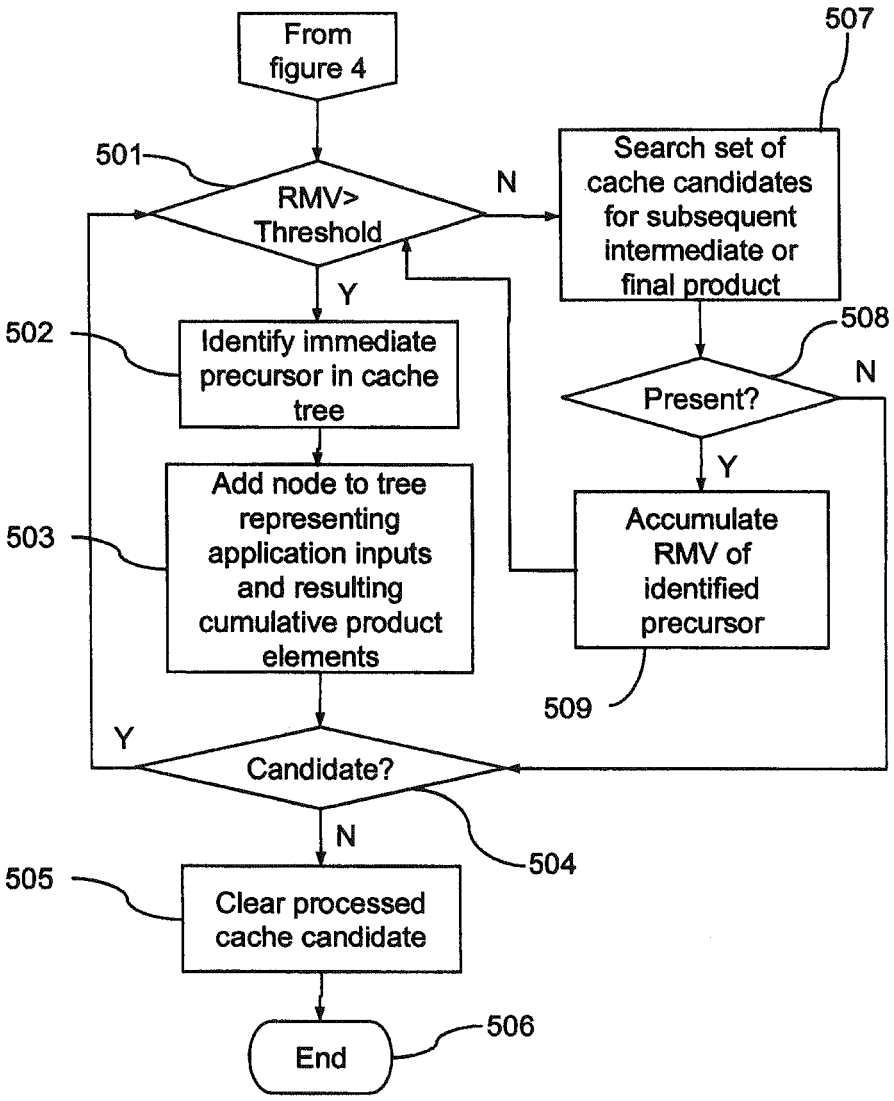

From figure 4
501
RMV> Threshold
N
Y
507
Search set of cache candidates for subsequent intermediate or final product
502
Identify immediate precursor in cache tree
508
Present?
N
Y
Add node to tree representing application inputs and resulting cumulative product elements
503
Accumulate RMV of identified precursor
509
Y
Candidate?
N
504
505
Clear processed cache candidate
End
506

Figure 5

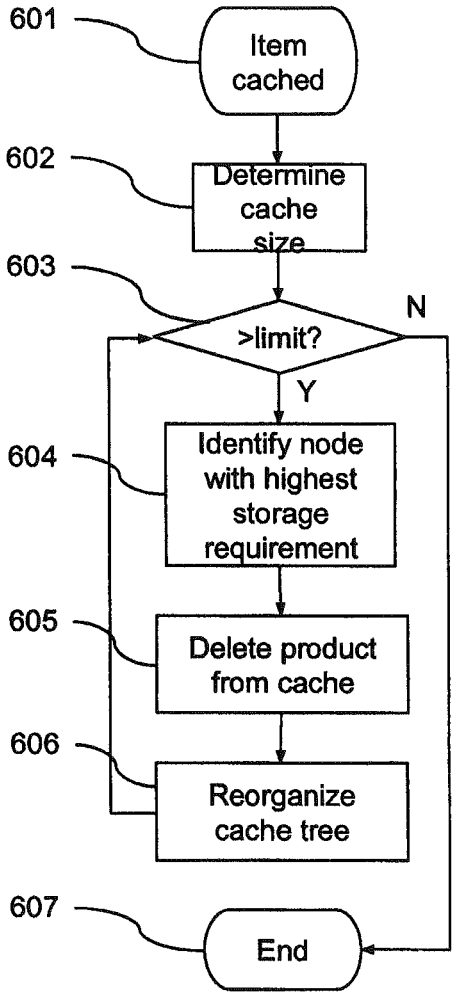

601
Item cached
602
Determine cache size
603
>limit?
N
Y
604
Identify node with highest storage requirement
605
Delete product from cache
606
Reorganize cache tree
607
End

Figure 6

MANAGING A CACHE FOR STORING ONE OR MORE INTERMEDIATE PRODUCTS OF A COMPUTER PROGRAM

PRIORITY

This application claims priority to Great Britain Patent Application No. 1218312.5, filed 12 Oct. 2012, and all the benefits accruing therefrom under 35 U.S.C. §119, the contents of which in its entirety are herein incorporated by reference.

BACKGROUND

The present invention relates to managing a cache and more specifically to managing a cache that stores one or more intermediate products of a computer program.

In computer systems, most application programs may be provided for producing products, which require significant amounts of computing resource to create. Furthermore, the products may be relatively large and require correspondingly large amounts of storage. Examples of such products comprise software, documents, images, video or audio. The products may be cached to enable re-use where appropriate. However, where relatively large numbers of products are provided by a given application program the management of the cache may become complex or the storage space required for such caching may be prohibitively large.

BRIEF SUMMARY

A method, system and program product is provided for managing a cache. In one embodiment, the method includes analyzing a first intermediate product of a computer program. The intermediate product is produced by the computer program in response to a set of control inputs received by the computer program. The method also includes identifying a resource measure associated with the production of the first intermediate product and determining a resource measure value by using the control inputs associated with the first intermediate product, The first intermediate product is then stored in the cache upon determination that the resource measure value exceeds a predetermined resource threshold.

Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein. For a better understanding of the disclosure with the advantages and the features, refer to the description and to the drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the disclosure are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** depicts a schematic diagram illustrating a software generated application program, in accordance with an embodiment;

FIG. **2** is a schematic diagram illustrating a set of modules having both intermediate products and final products generated by the software application program of FIG. **1**;

FIG. **3** is a schematic diagram illustrating an example of the output of the software generation application program of FIG. **1**;

FIG. **4** is a flow diagram illustrating a cache response generated in connection of an application program, in accordance with an embodiment;

FIG. **5** is a flow diagram illustrating processing performed by a cache manager, in accordance with an embodiment; and

FIG. **6** is a flow diagram illustrating a cache manager module, in accordance with an embodiment.

DETAILED DESCRIPTION

FIG. **1** illustrates a computer system **101** which comprises a computer **102** provided with an operating system **103** and running an application program **104** in the form of a software generation application program. In one embodiment, the application program **104** comprises a cache manager module **105**. The computer **102** is connected to first and second storage devices **106**, **107**. The first storage device **106** is arranged for storing a set of software modules **108** and the second storage device **107** is arranged for storing one or more of the software products **109** produced by the application program **104**. The application program **104** is arranged, in response to a set of one or more control inputs, in the form of one or more user inputs, to input and process a selected set of the modules **108** to produce one of the software products **109**. During the production of one or more of the software products **109**, the application program **104** may produce one or more intermediate products **110**. The intermediate products **110** may be stored on the second storage device **107** under the control of the cache manager **105** in accordance with a predetermined set of criteria as described further below. The cached intermediate products **110** are provided for subsequent processing by the application program **104**.

The application program **104** is arranged to produce each of the set of software products **109** from a selected set of the modules **108**. A proportion of the software products **109** are produced from one or more of the intermediate products **110**. FIG. **2** shows a product tree **201** for the present embodiment representing the set of all possible final software products **109** that may be produced by the application program **104** and their respective sets of one or more precursors in the form of the intermediate products **110**. Each node **202** of the tree **201** represents either a final software product **109** or an intermediate product **110**. Each arc **203** of the tree **201** is annotated with the sequence of control inputs **204** required to produce the lowermost intermediate product **110** or final software product **109** from the relevant precursors in the tree **201**. For any given node **202**, each subsequent arc **203** represents a point of variance in the tree **201** as a consequence of the associated control input and resulting in the succeeding node **202**.

In one embodiment, the cache manager **105** is arranged to consider each intermediate product **110** and final product **109** produced by the application program **104** for caching on the second storage device **107**. Each step of production, that is, the processing of a further one of the modules **108** with another module **108** or intermediate product **110**, is associated with a predetermined resource measure value (RMV). In the present embodiment, the resource measure is the number of central processing unit (CPU) cycles used by the computer **102** for processing the associated production step. In this embodiment, the application program **104** is arranged to record the RMV for each output intermediate or final product **110**, **109**. The cache manager **105** is provided with a predetermined threshold value for the resource measure. The cache

manager **105** is arranged to cache only intermediate products **110** or final products having a resource measure value exceeding the predetermined threshold. If a first intermediate product **110** has a resource measure value that does not exceed the predetermined threshold, the resource measure value of the first intermediate product **110** may be accumulated or inherited by one or more subsequent intermediate products **110** produced from the first intermediate product **110**. Thus, any given RMV for a given intermediate product **110** may be cumulative. In this embodiment, such accumulation or inheritance of RMVs by subsequent intermediate or final products is managed by the cache manager **105** as described further below.

In response to a request to the application program **104** for the relevant final product **109**, if the requested final product **109** has been cached, the cached version is provided to a requestor in lieu of a newly produced version. The cached intermediate products **110** are provided to the application program **104** in response to a request for a given product **109** so as to provide a processing precursor. In the present embodiment, the application program is arranged to output each relevant intermediate product **110** created in the production of a requested subsequent intermediate product **110** or final product **109**. Each such intermediate product **110** is considered by the cache manager **105** as a cache candidate.

In FIG. **3**, the cache manager is arranged to manage the contents of the cache **107** using a tree data structure **301** in the form of a cache tree. The cache tree **301** is structured in the same manner as the product tree **201** described above with reference to FIG. **2**. The cache tree thus comprises nodes **302** representing final products **109** or intermediate products **110** and arcs **303** representing a relevant sequence of control inputs **204**. While full labelling of the product tree **201** of FIG. **2** is provided, minimal labelling is used in the cache tree **301** of FIG. **3** for clarity. At any given point in time the cache tree **301** identifies all the final products **109** and associated production precursors in the form of the intermediate products **110** that have been produced by the application program **104** and that have an associated resource measure value exceeding the predetermined threshold. Therefore, not all intermediate products **110** produced by the application program **104** appear singly in the cache tree **301**. Instead, any intermediate product having an associated resource measure value that meets or falls below the threshold will only appear in the cache tree **301** as part of a subsequent intermediate product **110** or the resulting final product **109**.

Comparing the cache tree **301** to the product tree **201** of FIG. **2** it can be seen that two nodes **202** from the product tree **201**, representing the intermediate product **110** AB and the final product **109** P3 created from the modules **108** A, F, G, are not represented in the cache tree **301**. Since the cache tree **301** represents the contents of the cache **107**, that is, the cached products **109** or intermediate products **110**, the intermediate product **110** AB and the final product **109** P3 are not stored in the cache **107**. The absence of the intermediate product **110** AB in the cache tree **301** and consequently from the cache **107** results from the resource measure value for the intermediate product **110** AB meeting or falling below the predetermined threshold. However, the cumulative resource measure value for the subsequent intermediate product **110** ABC exceeded the threshold and is thus represented in the cache **107** and the cache tree **301**. The absence of the final product **109** P3 from the cache tree results from two possibilities: the production of the final product **109** P3 from the intermediate product **110** AF and the module **108** G generated a resource measure value meeting or falling below the predetermined threshold; or the application program **104** has not yet produced the final product **109** P3.

The processing performed by the cache manager **105** for managing the caching of the products of the application program **104** will now be described in further detail with reference to the flowchart of FIG. **4**. Processing of the cache manager **105** is initiated at step **401** in response to a request to the application program **104**, in the form of a set of one or more control inputs, to produce an intermediate or final product **110**, **109** and processing moves to step **402**. At step **402** the cache tree **301** is searched to identify a node representing the requested intermediate or final product **110**, **109** and if present processing moves to step **403**. At step **403** the intermediate or final product **110**, **109** identified in the cache tree is retrieved from the cache **107** and returned to the requestor in response to the input set of control inputs. Processing then moves to step **404** and ends. If at step **402** the intermediate or final product **110**, **109** is not identified in the cache tree **301** then processing moves to step **405**. At step **405** the cache tree **301** is further searched to identify any node representing a precursor to the requested intermediate or final product **110**, **109**, that is an intermediate product that is a predecessor in the production process for the requested intermediate or final product **110**, **109**, and if none is identified then processing moves to step **406**. At step **406** the request, in the form of the set of control inputs, is input to the application program **104** and processing moves to step **407**.

At step **407** the requested intermediate or final product **110**, **109** output by the application program **104** is passed to the requestor and processing moves to step **408**. Each such output intermediate or final product **110**, **109** produced from an identified precursor is associated with an RMV based on the number of CPU cycles required to produce that intermediate or final product **110**, **109** from the identified precursor but does not take into account any RMV previously associated with the precursor itself. At step **408** the newly produced requested intermediate or final product **110**, **109** and any relevant precursors are placed in a set of cache candidates in association with the respective resource measure values (RMVs). The set of cache candidates is ordered by relative production time. If at step **405** a precursor to the requested intermediate or final product **110**, **109** is identified in the cache tree **301** then processing moves to step **409**. At step **409** the corresponding intermediate product **110** is extracted from the cache **107** for input to the application program **104** in combination with the control input so as to enable the application to use the intermediate product **110** as a precursor for the production of the requested intermediate or final product **110**, **109**. Processing then moves to step **407** and proceeds as described above. Processing then moves to step **501** of FIG. **5**.

In one embodiment, when the application program **104** receives a cached precursor, for example at step **409**, it also is provided with a full set of control inputs for producing the requested intermediate or final product **110**, **109**. In the present embodiment, the application program **104** is arranged to identify the subset of those control inputs relevant to producing the requested intermediate or final product **110**, **109** from the precursor supplied from the cache **107**. In the present embodiment, the application program **104** identifies this subset of control inputs by from the difference between the control inputs **204** from the cache tree associated with the cached precursor and the control inputs provided as part of the request for the requested intermediate or final product **110**, **109**. Furthermore, as noted above, when producing a product based on such a precursor, the RMV for the precursor-based result is incremental, that is, comprises only the additional

resource measure value for producing the requested intermediate or final product **110**, **109** from the precursor. In other words, the RMV does not include at this point in the processing any element of the RMV for producing the precursor itself. This mechanism ensures that the precursor-based product does not have a falsely inflated RMV and is treated in a comparable manner to other cache candidates.

In FIG. **5**, at step **501**, in response to the production of a new set of one or more cache candidates, the resource measure value (RMV) for the first new cache candidate in sequence of production is compared to the predetermined threshold and if the RMV exceeds the threshold processing moves to step **502**. At step **502** the cache tree **301** is searched to identify the nearest precursor to the new cache candidate and processing moves to step **503**. At step **503** the cache candidate is stored in the cache **107** and a corresponding node **302** added to the cache tree **301** connected by an arc **303** to the identified nearest precursor. The new arc **303** is associated with data identifying the set of control inputs for producing the new cache candidate and processing moves to step **504**. At step **504**, if a further new cache candidate is present in the set then processing returns to step **501** and proceeds as described above. If at step **504** no new cache candidate is present then processing moves to step **505**. At step **505** the processed set of cache candidates is cleared and processing moves to step **506** and ends. If at step **501** the RMV for a given cache candidate meets or falls below the predetermined threshold then processing moves to step **507**. At step **507** the set of cache candidates is searched for any previously considered intermediate product comprising an immediate precursor to the current cache candidate and processing moves to step **508**. At step **508** if no such precursor is identified then the current cache candidate is marked as processed but left in the set of cache candidates as a possible precursor for subsequently processed cache candidates. Processing then moves to step **504** and proceeds as described above. If at step **508** a precursor cache candidate is identified then processing moves to step **509** where the RMV of the precursor cache candidate is accumulated in the RMV of the current cache candidate and processing moves to step **501** where the new RMV of the current cache candidate, that is, the current RMV with the inherited RMV from the identified precursor cache candidate, and processing proceeds as described above until all unprocessed new cache candidates have been processed as described above.

In one embodiment, at any given time the set of cache candidates may comprise cache candidates that have been processed as described above, marked as processed, but remain in the set of cache candidates because their respective RMV meets or falls below the RMV threshold. Such processed but remaining cache candidates provide a mechanism for the inheritance of their respective RMVs by subsequent cache candidates which may then have sufficiently high RMVs to be cached or may themselves be marked as processed but maintained in the set of cache candidates.

In another embodiment, the cache manager **105** is further arranged to manage the overall size of the cache **107** within a predetermined storage threshold. The size of the cache is determined each time a cache candidate is added to the cache **107** in step **503** and if the storage threshold is exceeded the cache **107** is pruned in accordance with a predetermined rule. In the present embodiment, the predetermined rule determines that the largest member of the cache is deleted first and the process repeated until the cache **107** meets or falls below the storage threshold.

The processing performed by the cache manager **105** when managing the size of the cache will now be described with reference to the flow chart of FIG. **6**. Processing is initiated at step **601** in response to the addition of a cache candidate to the cache **107** and processing moves to step **602**. At step **602** the current size of the cache **107** is determined and processing moves to step **603**. At step **603** the current size of the cache **107** is compared to the storage threshold and if the storage threshold is exceeded processing moves to step **604**. At step **604** the cache **107** is searched to identify the final or intermediate product **110**, **109** occupying the greatest storage and processing moves to step **605**. At step **605** the identified largest final or intermediate product **110**, **109** is deleted from the cache **107** and processing moves to step **606**. At step **606** the cache tree **301** is reorganised accordingly to take the removal of the largest final or intermediate product **110**, **109** into account and processing returns to step **603** and proceeds as described above until at step **603** the size of the cache **107** meets or falls below the storage threshold. At this point, processing moves to step **607** and ends.

In one embodiment, each intermediate or final product is associated with metadata comprising at least one of its relevant set of control inputs. As will be understood by those skilled in the art, any suitable arrangement for recording the relevant set of one or more control inputs required to produce a given intermediate or final product may be provided suitable for a given implementation.

The sets of control inputs in embodiments described above are clearly associated by their label, such as A+B+C, with the names of the modules from which they are produced. As will be understood by those skilled in the art, in some embodiments, there may be no such association. In such embodiments, the application program or the cache manager is provided with suitable data for correlating modules, sets of control inputs and relevant intermediate or final products as required. As will be understood by those skilled in the art, the structure of the cache tree **301** is maintained in accordance with known tree maintenance principles. For example, appending or inserting a node at the appropriate point where in the absence of an immediate precursor/intermediate product or deletion of one or more nodes and the subsequent restructuring/reorganisation of the tree so as to fully represent the revised contents of the cache. As will be understood by those skilling the art, any suitable data structure, not limited to tree data structures, may be employed for representing the relationships between the intermediate and final products stored in the cache. In addition, it is understood that the cache contents and the associated cache tree or other suitable data structure may be stored in any suitable storage arrangement which may comprise one or more monolithic or distributed physical or virtual storage arrangements.

In another embodiment, RMV values may be stored in association with any member of the cache tree. Yet in another embodiment, the cache manager is arranged to take account of both storage size and RMV for each cached item when identifying a node to prune from the cache. In other words, the pruning threshold is a composite threshold that balances the storage requirement of an item against the resource required to produce the item. Thus in this embodiment, each cached item is associated with data representing the relevant RMV. Therefore, a large cache item with a large RMV would be kept in preference to a similarly large item with a smaller RMV. One method of achieving such a composite threshold would be to divide storage size by RMV to give a cost to benefit ratio (T). When pruning the cache, items with higher values of T would be pruned until the cache was within the required limits. As will be understood by those skilled in the art, if an item is simply too large for the cache it would be discarded regardless of its T value. As will be understood by those

skilled in the art, any suitable resource usage or performance measure and associated threshold may be used for determining whether or not a given intermediate or final product should be cached or pruned from the cache. The resource measure may be performed by the application program as in embodiments described above or may be performed by a separate module or application program. The performance measure may use data generated by a third party program such as a processor activity monitor or other such CPU performance monitoring or measuring program.

In yet another embodiment, the application program is arranged to respond to requests for the production of a final products but not to respond to requests for an intermediate product. As will be understood by those skilled in the art, any suitable mechanism may be provided for providing the inheritance of RMV of precursors to subsequent intermediate or final products. In some embodiments, such RMV inheritance may be performed by the application program.

Those embodiments that enable caching of selected intermediate products so as to enable their re-use in producing subsequent products. This results in the performance of the software generation application program and associated computer being improved in speed or processing efficiency. In other words, a cached intermediate product reduces the processing resources or time required to produce an associated final product.

As will be appreciated by one skilled in the art, aspects of the present invention may be embodied as a system, method, computer program product or computer program. Accordingly, aspects of the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment (including firmware, resident software, micro-code, etc.) or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit," "module" or "system." Furthermore, aspects of the present invention may take the form of a computer program product embodied in one or more computer readable medium(s) having computer readable program code embodied thereon.

Any combination of one or more computer readable medium(s) may be utilized. The computer readable medium may be a computer readable signal medium or a computer readable storage medium. A computer readable storage medium may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples (a non-exhaustive list) of the computer readable storage medium would include the following: an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. In the context of this document, a computer readable storage medium may be any tangible medium that can contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device.

A computer readable signal medium may include a propagated data signal with computer readable program code embodied therein, for example, in baseband or as part of a carrier wave. Such a propagated signal may take any of a variety of forms, including, but not limited to, electro-magnetic, optical, or any suitable combination thereof. A computer readable signal medium may be any computer readable medium that is not a computer readable storage medium and that can communicate, propagate, or transport a program for use by or in connection with an instruction execution system, apparatus, or device.

Program code embodied on a computer readable medium may be transmitted using any appropriate medium, including but not limited to wireless, wireline, optical fiber cable, RF, etc., or any suitable combination of the foregoing.

Computer program code for carrying out operations for aspects of the present invention may be written in any combination of one or more programming languages, including an object oriented programming language such as Java®, Smalltalk, C++ or the like and conventional procedural programming languages, such as the "C" programming language or similar programming languages. The program code may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). Java and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.

Aspects of the present invention are described below with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems) and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer program instructions may also be stored in a computer readable medium that can direct a computer, other programmable data processing apparatus, or other devices to function in a particular manner, such that the instructions stored in the computer readable medium produce an article of manufacture including instructions which implement the function/act specified in the flowchart and/or block diagram block or blocks.

The computer program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other devices to cause a series of operational steps to be performed on the computer, other programmable apparatus or other devices to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that, in some alternative implementations, the functions noted in the block may occur out of the order noted

in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions.

While the invention has been illustrated by the description of the embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details of the representative apparatus and method, and illustrative examples shown and described. Accordingly, departures may be made from such details without departure from the scope of applicant's general inventive concept.

What is claimed is:

1. A method for managing a cache, comprising:

analyzing a first intermediate product of a computer program, wherein the intermediate product is produced by the computer program in response to a set of control inputs received by the computer program;

identifying a resource measure associated with the production of the first intermediate product, the resource measure including a number of central processing unit (CPU) cycles used by the computer for processing the first intermediate product;

determining a resource measure value by using the control inputs associated with the first intermediate product; and

storing the first intermediate product as a discrete entry in the cache upon determination that the resource measure value exceeds a predetermined resource threshold.

2. A method according to claim **1**, wherein the control inputs are stored in association with the first intermediate product in the cache.

3. A method according to claim **1**, further comprising calculating a cumulative resource measure for the first intermediate product.

4. A method according to claim **3**, further comprising storing the cumulative resource measure in the cache when the cumulative resource measure value exceeds a predetermined resource threshold.

5. A method according to claim **1**, wherein in response to a request for a given product, searching the cache for any intermediate product associated with the computer program for that requested product.

6. A method according to claim **5**, wherein when at least one intermediate product is identified, providing complete stored information related to that identified intermediate product for the requested product.

7. A method according to claim **5**, wherein any intermediate product that exceeds a predetermined size limit is excluded from storage in the cache.

8. A method according to claim **1**, wherein the cache has a tree data structure such that each node represents an intermediate product having a cumulative resource measure value exceeding a preselected threshold.

9. A method according to claim **1**, wherein there is an arc between two nodes of the tree data structure such that an arc represents a second and a third intermediate product associated with sets of control inputs relating to the computer program for producing the third intermediate products from the second intermediate product.

10. A method according to claim **8**, wherein the node representing any given intermediate product is added to the tree at a point of divergence from a common preceding intermediate product.

11. A method according to claim **8**, wherein the tree is used in response to a request for providing a given intermediate product stored in the cache.

12. A method according to claim **1**, wherein a plurality of final products are stored in the cache and associated with one or more intermediate products.

13. A cache management system comprising

a computer configured to run at least one computer program;

a cache in processing communication with the computer and configured to store a plurality of intermediate products produced by the computer program, wherein an intermediate product is produced by the computer program in response to a respective set of control inputs to the computer program;

the computer configured for determining a resource measure associated with the production of a first intermediate product, the resource measure including a number of central processing unit (CPU) cycles used by the computer for processing the first intermediate product;

the computer also configured for calculating a resource measure value for the first intermediate product in response to a first set of control inputs associated with the computer program; and

the computer further configured for storing the first intermediate product as a discrete entry in the cache when the value of the resource measure exceeds a predetermined resource threshold.

14. The system according to claim **13**, wherein the first set of control inputs is also stored when the first intermediate product is stored in the cache.

15. The system according to claim **13**, wherein the computer is configured to search the cache for a given product associated with an intermediate product in response to a request for identifying any identified intermediate product.

16. The system according to claim **13**, wherein the computer excludes storing in the cache any intermediate product that exceeds a predetermined size.

17. The system according to claim **13**, wherein the cache is managed using a tree data structure and the tree is used for identifying one or more associated intermediate products.

18. The system according to claim **17**, wherein the tree has nodes such that each node represents a given intermediate product at a point of divergence from a common preceding intermediate product.

19. A computer program product for managing stored data in a cache, the computer program product comprising:

a non-transitory computer readable storage medium having computer readable program code embodied therewith, the computer readable program code comprising computer readable program code configured for:

analyzing a first intermediate product of a computer program, wherein the intermediate product is produced by the computer program in response to a set of control inputs received by the computer program;

identifying a resource measure associated with the production of the first intermediate product, the resource measure including a number of central processing unit (CPU) cycles used by the computer for processing the first intermediate product;

determining a resource measure value by using the control inputs associated with the first intermediate product; and

storing the first intermediate product as a discrete entry in the cache upon determination that the resource measure value exceeds a predetermined resource threshold.

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